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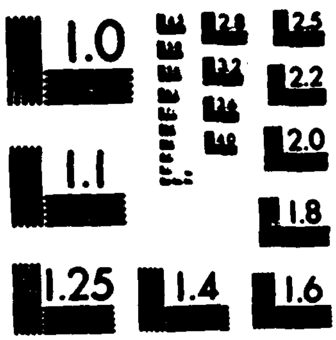

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SURVEY OF SMALL SCALE HEAT RECOVERY INCINERATORS

February 1983

An Investigation Conducted by
CAL RECOVERY SYSTEMS, INC.
Richmond, California

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METRIC CONVERSION FACTORS

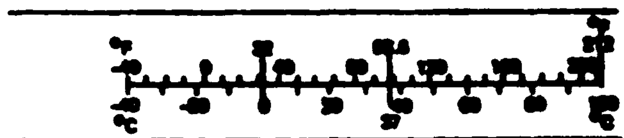
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2,000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1,000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Solid waste heat incinerator (HRI) facilities within the United States, which were capable of 24-hr/day operation, had operated for about a year, and had combustors of between 0.75 - 3.00 ton/hr capacity were identified to permit selection of best facilities for field visits. Thirteen manufacturers of HRI were identified.

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TABLE OF CONTENTS

INTRODUCTION

The Resource Conservation and Recovery Act (RCRA) of 1976 requires that waste derived fuels be used to the maximum extent practicable in federally-owned facilities. In response to this legislation, the U.S. Department of Defense has conducted numerous studies in resource recovery and has installed and is operating several waste-to-energy systems. Since the late 1970's, evidence has accumulated indicating that waste-to-energy plants in the 20 to 200 TPD range are technically and economically viable. A large number of modular incinerator systems with heat recovery are now in operation, and it is expected that the number will grow rapidly in the next few years.

In July 1982, Cal Recovery Systems prepared a report for the Navy in which details of capital, operating and maintenance costs for starved-air heat recovery incinerators were presented.(1) In September 1982, the material in this report was supplemented with a statistical analysis of costs and reissued as a Technical Memorandum by the Naval Civil Engineering Laboratory.(2) The following report provides additional design, performance and cost data for both starved air and excess air heat recovery incinerators.

DATA COLLECTION METHODS

Manufacturers and vendors of heat recovery incinerators were identified through a search of the literature and contacted for a list of their heat recovery incinerators in the 0.75 to 3.0 ton per hour capacity range. The owners and operators of the incinerator equipment were then contacted. Data on design, performance and costs were then compiled by carefully

following a format of questioning developed in the planning stage of the study.

DATA AVAILABILITY

In general, manufacturers and vendors were responsive to the survey. All those contacted supplied a list of operating facilities meeting the required range of specifications. Some also supplied the names and telephone numbers of plant owners and managers. To the knowledge of the author, these lists were representative and complete for manufacturers investigated except for plants which had been shut down either permanently or for an extensive period of time.

Owners and operators of plants were usually cooperative when contacted. Available technical information on their system was supplied generally without reservation. However, some owners would provide only minimal design data as a result of a continuing dispute with the manufacturer and the possibility of future litigation. In addition, some manufacturers and owners held the belief that supplying certain types of data would damage their strong competitive posture in a lucrative waste-to-energy market.

Most owners and operators supplied available information on capital costs. In contrast, recurring operation and maintenance costs were exceptionally difficult to obtain. Many plant managers did not compile any of their operating cost data. A small number of owners/operators were able to supply total operating costs, and a significantly fewer number were able to provide a breakdown of these costs. In some cases, the total operating cost was an annual fee paid by the owner to a subcontractor.

PROCESS DESCRIPTIONS

Modular heat recovery incinerators (HRI) are generally characterized as being factory assembled and designed for staged combustion with combustion air control. A number of modules may be integrated to increase overall capacity and plant reliability. Use of common ancillary equipment may also result in reduced capital and operating costs.

Both starved-air and excess air incinerator designs are available. Air and auxiliary fuel flow can be preset in accordance with feedstock throughput and heating value or continuously modulated in response to combustion chamber temperature. In the starved-air design, a substoichiometric quantity of air is introduced into the primary combustion chamber. The fuel gas and particulates produced are combusted in the secondary combustion chamber. In the excess air design, air in excess of stoichiometric requirements is introduced into both primary and secondary combustion chambers. Whereas auxiliary fuel may only be required intermittently in the starved-air design, the requirement is continuous in the excess air design.

In essence, the secondary combustion chamber in the excess air incinerator acts as an afterburner. Excess air incinerator manufacturers claim that in this way control of emissions is enhanced. They also claim that excess air operation enables operation at design capacity and reduces the carbon content of the residue. On the other hand, starved-air incinerator manufacturers claim that starved-air operation requires less combustion air and that, consequently, the power requirements of fan motors are reduced and the lower gas velocities reduce particulate entrainment.

Process descriptions of available heat recovery incinerators are described in the following pages. Design differences are highlighted and the overall performance of each system described.

BASIC ENVIRONMENTAL ENGINEERING

Basic Environmental Engineering has furnished numerous incinerators to various solid waste generating facilities. Data from seven of these are presented in Appendix B. All are excess air-type models ranging from 2500 to 10,000 pounds per hour in design capacity. Different types of industrial and municipal wastes are incinerated and recovery is practiced at each facility. One of the incinerators is fitted with a scrubber to remove HCl from the combustion of plastics.

The most recent Basic design utilizes a suspended, agitated hearth in conjunction with waterwall heat recovery in the primary chamber. The hearth consists of a suspended brick furnace floor in step configuration with air jets along the steps. The hearth intermittently reciprocates and the solid waste is combusted as it moves along the length of the combustion chamber. At the end of the hearth the ash falls into a water sealed pit and is mechanically scooped out by a dragline ash removal system.

Approximately 30 percent of the steam output is generated in the waterwalls of the primary chamber. Excess air and combustion products pass from the primary combustion chamber through a convection section where additional steam output is produced in a conventional bare-tube feedwater boiler. Steam output ranges from 10 million to 56 million Btu/hr using an economizer. Steam pressures up to 625 psi are available using this type of design.

BRULÉ

Brulé offers a 6000 pound/per hour starved air heat recovery incinerator utilizing three stage combustion. Data from two facilities burning industrial waste are shown in Appendix C. Usual components of the Brulé system include feed and ash removal mechanisms, combustion chambers, auxiliary feed burners, a heat recovery boiler, stacks (dump stack and energy stack) and controls. A facility in Milwaukee, WI, is fitted with a scrubber although the rationality for this is not clear.

As is the case with most of the other designs, waste material is charged into the primary combustion chamber of a Brulé incinerator using a hydraulic ram. Stoichiometric air is added to the primary chamber and the combustible fuel gases produced are burned with 40 to 100 percent excess air in secondary and tertiary combustion chambers. The combustion gases leaving the tertiary chamber are first passed through an air cyclone to remove particulates and then a water tube heat exchanger for energy recovery. The ash residue drops through grates in the primary chamber into a quench or dry pit.

CLEAR AIR

Clear Air offers both starved and excess air incinerators. Four starved air models are offered with throughput capacities ranging from approximately 2100 to 4000 pounds per hour. Five excess air models have capacities ranging from 6000 to 16,000 pounds per hour. Data from one of these facilities are shown in Appendix J. Typical components included in both starved and excess air systems are feed and ash handling mechanisms, primary and secondary combustion chambers, grates, auxiliary burners, a boiler section, stacks, and controls.

In the starved air models a hydraulic feed ram deposits waste material in the primary chamber where it is burned under sub-stoichiometric

conditions. A reciprocating grate moves the material through the primary chamber. Ash is dropped into a quench pit from which it is removed via a drag conveyor. The fuel gas from the primary chamber passes to a secondary combustion chamber where a temperature-controlled auxiliary fuel burner completes the combustion process. Combustion gases leaving the secondary combustion chamber are then drawn through a heat recovery boiler and exhaust stack. A dump stack provides for the venting of combustion product gases when energy recovery is not required. A temperature controlled burner in the secondary combustion chamber maintains a preset temperature by modulating combustion air and auxiliary fuel gas.

In the excess air model, waste material is moved through the chamber and ash is deposited in the same way as with the starved air system. Combustion products pass from the primary chamber over a bridge wall and under a drop arch into the secondary chamber. Gas velocity is reduced in the secondary chamber to allow for particulate settling prior to entrance into the boiler section.

COMPTRO

Comptro offers three starved air heat recovery incinerator models having capacities in the range of 1450 to 2670 pounds per hour. Major components include a ram charging device, primary and secondary combustion chambers, a heat recovery unit and a stack and controls. Automatic ash removal is optional. Data for four facilities are shown in Appendix D. Typically waste is charged by hydraulic rams and ash is pushed to the rear of the primary chamber by injection of new waste materials. On units with an optional automatic ash removal system, a door in the bottom rear of the primary chamber periodically opens and ash drops into a holding container. By varying the stroke of the hydraulic rams, the throughput is controlled to achieve maximum burnout. Combustion is also

regulated in both combustion chambers by modulating air flow and using auxiliary fuel to maintain chamber temperatures. The secondary chamber is designed to maintain gas throughput at a temperature of 1800°F for approximately one second. The by-pass damper allows gases to be drawn through the heat recovery boiler in proportion to energy demand.

A unit in Darlington, PA, is fitted with a scrubber to control emissions from the combustion of solvents. Available data indicates that operational problems and costs associated with this equipm are substantial.

CONSUMAT SYSTEMS

The Consumat incinerator is a two-chamber unit designed for starved air operation. Consumat currently offers eight units ranging from 1250 to 8,400 pounds per hour in capacity.

Unit operation involves loading waste into a ram feeder by tractor and automatically injecting the material into the primary combustion chamber. Transfer rams then move the material slowly through the system. The primary combustion chamber is provided with a substoichiometric quantity of air so that a fuel gas is generated. This fuel gas is fed to the upper secondary combustion chamber and combusted with air which is controlled to maintain a preset fuel-to-air ratio and combustion chamber temperature. The combustion gases then pass into a heat exchanger where steam is produced. A steam separator ensures high quality steam. When steam is not required, combustion gases are vented through the dump stack. The ash residue is quenched and then conveyed to a closed bottom container.

In addition to the single module plant, Consumat offers a number of module combinations providing plant capacities up to 500 tons per day. These module combinations are: a) two starved-air chambers combined with

a single secondary combustion chamber feeding a single boiler ('Dual' system), b) three starved-air chambers combined with three secondary combustion chambers and two boilers ('Tri-Pac' system), and c) four starved-air chambers coupled to either two or three boilers ('Quad-Pac' system). The manufacturer claims that compared to the single unit systems, multiple unit systems offer reduced capital cost; more uniform gas and steam flows; large turn-down capacity ratios with minimal reduction in overall efficiency; and inexpensive system redundancy to facilitate routine maintenance and seasonal load variation. Data from twenty-eight Consumat facilities are presented in Appendix E.

ECONO-THERM

Two starved-air incineration systems are offered by Econo-Therm, and are designed to process 1500 and 2000 pounds per hour of waste. A hydraulic ram feed mechanism, primary and secondary combustion chambers, a low pressure heat recovery boiler with induced draft fan, and a single stack are characteristic of the system. The secondary combustion chamber includes a combustion tunnel followed by a series of baffles to entrain particulates. Ash residue is either manually removed or automatically dumped (in a dry state in both cases).

Data from three Econo-Therm facilities are presented in Appendix E.

ENVIRONMENTAL CONTROL PRODUCTS (E.C.P.)

E.C.P.'s line of three starved air models designed to process between approximately 1475 and 2400 pounds per hour of industrial and municipal wastes. Standard equipment includes primary and secondary combustion chambers, a waste-heat boiler, flue gas stacks, burners, fans, associate electrical and plumbing equipment, a fuel and air controller and a brick hearth. An automatic ram loading mechanism and ash removal system are commonly employed.

As is the case with most designs, material is fed into the charging hopper and forced into the primary combustion chamber by a hydraulic ram. Waste is constantly moved along the length of the tiered primary chamber by the hydraulic ram mechanism and is burned under substoichiometric air conditions to produce a volatile gas. Ash is pushed into a quench pit at the end of the primary combustion chamber and typically conveyed either continuously or intermittently into a storage hopper. The fuel gas enters the secondary chamber where sufficient air is added to burn it to completion. Combustion gases are drawn through a fire tube waste-heat boiler by an induced draft fan to produce steam or hot water. A control system monitors combustion chamber temperatures, adjusts combustion air and modulates chamber burners according to energy requirements. Data from thirteen facilities are presented in Appendix G.

GIERY

Giery offers two models of starved air incinerators designed to burn 2000 and 6000 pounds per hour of waste per day, respectively. A typical system includes a feed conveyor, primary and secondary rotary combustion chambers, primary burner, heat recovery boiler, and stack. The secondary combustion chamber does not have a burner.

The process of incineration and heat recovery involved introducing waste material from a conveyor into the top of a rotating combustion unit where it is burned under starved air conditions. The resultant fuel gases are burned to completion in a vertical after-burner section where secondary air is introduced in a tangential mode. Ash continually drops through grate bars in the rotary drum. An induced draft fan draws the combustion gases from the secondary chamber through a heat recovery boiler and any air pollution control equipment before discharge to the atmosphere.

KELLEY

Kelley offers two starved air heat recovery incinerator models capable of processing approximately 1300 and 2600 pounds per hour of wastes. The secondary combustion chamber in the Kelley design consists of a thermal reactor just slightly larger in diameter than the duct which connects it to the primary chamber. The principles of operation and process flow involved in Kelley heat recovery incinerator systems are as follows.

Waste is injected into the primary combustion chamber with an automatic ram. Fuel gases produced by decomposition in the primary chamber under starved-air conditions are burned to completion in the secondary chamber. Energy is recovered by drawing the combustion gases from the secondary chamber through a fire tube waste-heat boiler. Unlike the Consumat or E.C.P systems, a single stack is used with Kelley incinerators. A modulated damper situated between the boiler and the induced draft fan permits part or all of the combustion gases to flow through the boiler. Ash is removed either manually or by means of an automatic ram mechanism. Data for thirteen facilities are presented in Appendix H.

MORSE BOULGER

Excess air models are offered by Morse Boulger with throughput capacities ranging from 1300 to 4700 pounds per hour. The principal components of these models include a loading ram, primary and secondary combustion chambers, boiler, stack and controls. The process of incineration and heat recovery is as follows.

A charging ram feeds waste into the primary combustion chamber of the controlled air unit. An internal ram moves material to the back of the chamber where ash is discharged into a storage pit. Combusted gases

and particulates from the primary chamber are passed through a secondary combustion chamber and then through a heat exchanger. An induced draft fan ejects the spent combustion gases to a stack. Data from one Morse-Boulger facility are presented in Appendix J.

SIMONDS

Four starved air incinerators with heat recovery are offered by Simonds in the 1500 to 3600 pounds per hour range.

The waste incinerators incorporate hydraulic ram waste loading, dual chamber combustion, a fire tube waste-heat boiler, and automatic ash removal options. Systems with heat recovery utilize the same type of damping and exhaust discharge scheme as described for the Kelley units. Waste charging takes place approximately every 10 minutes. The combustion chamber temperature is sensed and the feed rate is automatically controlled to maintain a preset temperature. Data from five Simonds facilities are presented in Appendix I.

THERM-TEC

Therm-Tec offers three starved air models ranging in capacity from approximately 1250 to 3000 pounds per hour. The main components of a typical system include the ram feeder, primary and secondary combustion chambers, a heat recovery unit, energy and dump stacks, and controls.

Waste throughput and energy recovery processes for this system resemble those of the Consumat system, i.e., hydraulic ram feed, partial combustion of waste in the primary chamber, and complete combustion of fuel gases in a secondary chamber. Combustion gases vent through a stack after exiting the heat recovery boiler, or through a dump stack when energy is not being recovered. Ash is moved to the rear of the primary combustion chamber by a moving grate where it is discharged into a holding pit. Data from one Therm-Tec facility are presented in Appendix J.

U.S. SMELTING FURNACE CO.

U.S. Smelting Furnace Company manufactures three models of starved air incinerators ranging in capacity from 1500 to 2500 pounds per hour. Standard equipment includes a ram loader, primary and secondary combustion chambers, heat recovery boiler, stack, and controls. The incineration and energy recovery process is as follows.

Waste is charged into the starved air incinerator by a hydraulic ram. Material is pushed to the rear of the primary chamber as it burns, and ash is discharged into a pit. The system includes a single stack. If heat recovery capability is required, an induced draft fan draws combustion gases through the heat recovery boiler prior to their discharge to the atmosphere through the stack. When heat recovery is not desired, the induced draft fan does not operate and gases go directly out the stack from the secondary chamber. Facility data for a U. S. Smelting Furnace are presented in Appendix J.

WASHBURN AND GRANGER

Washburn and Granger offer starved air incinerator models with heat recovery having waste waste throughput capacities ranging from 1100 to 2000 pounds per hour. Automatic feed system and stoker grates are optional. Automatic ash removel is offered on systems designed to burn more than 800 pounds per hour of waste. Facility data for one Washburn and Granger incinerator are presented in Appendix J.

DESIGN AND FACILITY DATA

DESIGN DATA

Design data for 51 heat recovery incinerator models which meet the requirements of this study are shown in Tables A-1 and A-2 in Appendix A. Thirteen manufacturers are represented. Three manufacturers offer excess air and eleven offer starved-air designs. One manufacturer, Clear Air, offers both types of design.

Unit design capacities range up to 8,400 pounds per hour for starved-air models and 16,700 pounds per hour for excess air models. All manufacturers contacted offer a complete package of ancillary equipment including fuel and ash handling equipment, heat exchanger (boiler), stack and controls.

Most of the larger units have automated feed; some also have an optional manual feed. Ash is usually discharged from the primary combustion chamber by hydraulic ram and quenched in a holding tank.

Primary and secondary air and auxiliary fuel are generally controlled by temperature sensors. Air handling equipment may be either forced or induced draft, or both.

Auxiliary fuel burners are usually located in both primary and secondary combustion chambers. The primary combustion chamber burner is used to start ignition and assist in the combustion of high moisture content wastes. The secondary combustion chamber burner is operated more frequently and in some cases continuously (e.g., excess air models) to oxidize organic gases and particulates generated in the primary combustion chamber. In most cases, steam for process heating is generated. If the feedstock contains substantial halogenated organics (e.g., plastics

and solvents), a scrubber may be required for air emission control. If strict control on particulate emissions is required a baghouse may be warranted.

FACILITY DATA

As a result of discussions with the incinerator manufacturers a total of 80 heat recovery incinerator facilities were identified. Site specific details of design, operation and costs are shown for each manufacturer in Appendices B through J.

A review of these data has lead to the following observations:

(1) Most facilities process multi-component industrial or municipal wastes. Incineration of industrial waste is more prevalent. At several plants, waste solvents and combustible sludges are also injected.

(2) Most facilities consist of a single module. Those manufacturers who have experience in assembly and installation of multiple unit systems are Comptro, Consumat, Environmental Control Products and Kelley.

(3) Many facilities have been modified since installation. These modifications are often associated with the hydraulic feed or ash removal systems.

(4) A number of facilities are designed to generate steam up to 300 psig. Very few facilities generate electricity from steam heating.

(5) Several facilities are equipped with air pollution control equipment. Scrubbers are used to control halogenated byproducts from combustion and baghouses are used to control particulates. Operating and maintenance costs for air pollution control equipment are high.

(6) Actual throughput is usually significantly lower than design throughput.

(7) Capital cost data is available for many facilities. This data, however, exhibits a wide range of variability. Items that affect plant capital cost per ton of waste processed are:

(i) number of units and unit design capacity

(ii) manufacturing methods and marketing strategy

(iii) materials of construction

(iv) inclusion of feedstock preparation and/or air pollution control equipment

(v) degree of unit redundancy

(vi) operating schedule

(vii) design modifications

(viii) extent of spare part inventory

(ix) feedstock heating value and moisture and ash contents

(8) Operation and maintenance cost data is generally incomplete and in many cases unavailable. Items that affect operation and maintenance costs per ton of waste processed are:

(i) number and type of O&M personnel

(ii) degree of automated control

(iii) labor rates

(iv) preventative maintenance practices and schedule

(v) operation of feedstock preparation and/or air pollution control equipment

(vi) feedstock characteristics including types of components, heating value and moisture and ash contents

(vii) use of auxiliary fuels (including combustible waste liquids)

(viii) type, duration, and frequency of repairs

(ix) regulatory classification of residue and subsequent transportation costs and tipping fee

(x) throughput and operating schedule

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1. Tuck, J.K., Glaub, J.C. and Savage, G.M., A Survey of Capital, Operating and Maintenance Costs for Starved-Air Heat Recovery Incinerators, Cal Recovery Systems, Richmond, California, July 1982.

2. Lingua, M. and Zimmerle, J., A Survey of Capital, Operating and Maintenance Costs for Starved-Air Heat Recovery Incinerators, Technical Memorandum No. 54-82-12, Naval Civil Engineering Laboratory, Port Hueneme, California, September 1982.

Appendix A

DESIGN DATA

Table A-1. Heat Recovery Incinerator Design:
Data Set No. 1

Manufacturer	No. of Models	Model Nos.	Type(1)	Cap.(2) lb/hr	Construction Method(3)	Components(4)							CV,(5) ft3		Air Supply(6)		Temp. Control(7)			Feed Mech(8)		Refractory Type(9)	
						PC	SC	HR	B	HE	C	S	PC	SC	FD	ID	PA	SA	AF	A	M	PC	SC
Basic Environmental Eng.	10	1250–7000	EA	1540–8600	F	X	X	RP	X	X	X	X			X	X	X	X	X	X		C	C
Brulé		FG-424	SA	6000	S	X	X	X	X	X	X	X	1220			X			X	X		C	C
Clear Air	4	CA 2000 CA 4000	SA	2100–4000	F	X	X	X	X	X	X	X				X	X	X	X	X		C	C
	5	EA 75–EA 200	EA	6300–16700	F	X	X	X	X	X	X	X				X	X		X	X		RB	C
Comptro	3	A-45	SA	1450	F	X	X	X	X	X	X	X	566	117	X		X	X	X	X		C	C
		A-48	SA	2100	F	X	X	X	X	X	X	X	762	320	X		X	X	X	X		C	C
		A-50	SA	2670	F	X	X	X	X	X	X	X	1022	470	X		X	X	X	X		C	C
Consumat	8	CS 760	SA	1250	F	X	X	X	X	X	X	X	760				X	X	X				
		CS 800	SA	1250	F	X	X	X	X	X	X	X	760		X	X	X	X	X				
		CS 1000	SA	1650	F	X	X	X	X	X	X	X	1000		X	X	X	X	X				
		CS 1200	SA	2100	F	X	X	X	X	X	X	X	1200		X	X	X	X	X				
		CS 1600	SA	3000	F	X	X	X	X	X	X	X	1600		X	X	X	X	X				
		CS 2000	SA	4100	F	X	X	X	X	X	X	X	2000		X	X	X	X	X				
		CS 3000	SA	6250	F	X	X	X	X	X	X	X	3000		X	X	X	X	X				
		CS 4000	SA	8400	F	X	X	X	X	X	X	X	4000		X	X	X	X	X				
Econotherm	2	CA 1500	SA	1500	F	X	X	X	X	X	X	X	580	209	X	X	X	X	X	X	X	C,RB	RB
		CA 2000	SA	2000	F	X	X	X	X	X	X	X	820	316	X	X	X	X	X	X	X	C,RB	RB
Environmental Control Prod.	3	1500T–	SA	1475–	F	X	X	X	X	X	X	X				X	X	X	X	X		C,R	C
		2500T		2400	F	X	X	X	X	X	X	X				X	X	X	X	X		C,R	C
Giery	2	25	SA	2100	F	X	X	X	X	X	X	X				X	X	X			X	C	C
		75	SA	6250	F	X	X	X	X	X	X	X				X	X	X		X		C	C
Kelley Co.	2	1280/72	SA	1380	F	X	X	X	X	X	X	X	346			X		X	X	X	X	C,RB	RB,C
	3	2500/125	SA	2650	F	X	X	X	X	X	X	X	675			X	X	X	X	X	X	C,R	RB,C
Morse Boulger	4	CAMD 10, 11,12	EA	1500	F	X	X	X	X	X	X	X				X	X	X	X	X	X	RB	RB
				2000	F	X	X	X	X	X	X	X				X	X	X	X	X	X	RB	RB
				2500	F	X	X	X	X	X	X	X				X	X	X	X	X	X	RB	RB
Simonds	4	4	SA	1545	F	X	X	X	X	X	X	X	496	138		X	X	X		X		C	C
		5	SA	2030	F	X	X	X	X	X	X	X	655	200		X	X	X		X		C	C
		6	SA	2770	F	X	X	X	X	X	X	X	890	284		X	X	X		X		C	C
		7	SA	3625	F	X	X	X	X	X	X	X	1163	327		X	X	X		X		C	C
Therm-Tec	4	EP 1000	SA	1250	F	X	X	X	X	X	X	X				X	X	X	X	X	X	C	C
		EP 1500	SA	1900	F	X	X	X	X	X	X	X				X	X	X	X	X	X	C	C
		EP 2500	SA	3100	F	X	X	X	X	X	X	X				X	X	X	X	X	X	C	C
U.S. Smelting Furnace Co.	1	1500 2000 2500	SA	1000–2500	F	X	X	X	X	X	X	X	155–639	53–162		X	X	X	X	X	X	C	C

(1) Starved air (SA); excess air (EA);
(2) Based on feedstock HV = 6,500 lb/hr
(3) Factory built (F) or site erected (S)
(4) PC = primary combustion chamber
SC = secondary combustion chamber
HR = hydraulic feed mechanism
B = gas or oil burners
HE = boiler or heat exchanger
C = controls
S = stack
RP = rack and pinion drive mechanism
(5) Combustion chamber volume (CV)
(6) Forced draft (FD); induced draft (ID)
(7) Temperature control of primary air (PA), secondary air (SA), auxiliary fuel (AF)
(8) Automatic (A); manual (M)
(9) Casteable (C); refractory block (RB)

Table A-2. Heat Recovery Incinerator Design:
Data Set No. 2

Manufacturer	Model	Auxiliary Fuel Burners: No.(1) PC	Auxiliary Fuel Burners: No.(1) SC	Auxiliary Fuel Burners: Unit Rating(2) MBtu/h	Ash Discharge System(3): M	Ash Discharge System(3): HR	Ash Discharge System(3): MG	Ash Cooling System(4): WQ	Ash Cooling System(4): WS	Liquid Injection Capability	Heat Exchanger (Boiler): Type(5)	Heat Exchanger (Boiler): Steam Pressure(6) psig	Heat Exchanger (Boiler): No. of Passes	FHS(7) ft^2
Basic Env. Engineering	1250-7000	1	1			x(8)					WW,FT, WT(9)	250,(9) 625(10)		
Bruié	FG-424	2	1	5				X		X	FT	600	1	
Clear Air (4 models)	CA 2000-CA 4000	1	1				X	X		X	FT	250	1	
	EA75-EA200	1	1				X	X		X	FT,WT	250	1	
Comptro	A-45	1	1	2.5		X		X		X	FT,WT	200-600	1-2	1000-2500
	A-48	1	1	2.5		X		X		X	FT,WT	200-600	1-2	1000-2500
	A-50	1	1	2.5		X		X		X	FT,WT	200-600	1-2	1000-2500
Consumat	CS 760	1	1			X		X		X	WT		1	
	CS 800	1	1			X		X		X	WT		1	
	CS 1000	1	1			X		X		X	WT		1	
	CS 1200	1	1			X		X		X	WT		1	
	CS 1600	1	1			X		X		X	WT		1	
	CS 2000	1	1			X		X		X	WT		1	
	CS 3000	1	1			X		X		X	WT		1	
	CS 4000	1	1			X		X		X	WT		1	
Econotherm	CA 1500	1	1	0.4		X		X	X	X	FT		3	1000
	CA 2000		1	1.5		X		X	X	X	FT		3	1500-2000
Environmental Control Prod.	1500T-	1(11)	1(11)			X		X		X	FT	150	3	
	2500T	1	1			X		X		X	FT	150	3	
Giery	25	1	0	0.8			X			X	FT,WT	125-150	1-2	
	75	1	0	3			X			X	WT		1	
Kelley Co.	1280/72		1	0.8	X	X			X	X	FT		3	875
	2500/125	1	2	0.8	X	X			X	X	FT		3	1500
Morse Boulger	CAMD 10, 11,12	2	1		X	X				X	FT		3	
Simonds	4	1	2	0.4		X		X		X	FT	200	3	1250
	5	1	2	1.4		X		X		X	FT	200	3	1750
	6	1	2	1.4		X		X		X	FT	200	3	2500
	7	1	2	2.0		X		X		X	FT	200	3	3000
Therm-Tec	EP 1000	1	1				X		X	X	FT	125	1	
	EP 1500	1	1				X		X	X	FT	125	1	
	EP 2500	1	1	3.5			X		X	X	FT	125	1	
U.S. Smelting and Furnace Co.	1500 2000 2500	1(7)				X				X	FT	150	3	400-1750

(1) No. of burners in primary combustion chamber (PC) and secondary combustion chamber (SC)
(2) Maximum for secondary combustion chamber
(3) Manual (M); hydraulic ram (HR); moving grate (MG)
(4) Water quench (WQ); water spray (WS)
(5) Firetube (FT); watertube (WT); waterwall (WW)
(6) Design steam pressure
(7) Fireside heating surface (FHS)
(8) Pulse hearth
(9) Watertube and firetube
(10) Waterwall
(11) Number of burners depends on model

Appendix B

BASIC ENVIRONMENTAL ENGINEERING

Table B-1. Facility Contact Data

Incinerator Manufacturer: Basic Environmental Engineering, Inc., Glen Ellyn, Illinois
Contact: Reynaldo C. Familar (312) 469-5340

Owner	Location	Operator	Contact/Phone No.
The Nelson Co.	Sparrows Point, MD	Owner	Peter Caltrider (301) 477-3000
Masonite Corp.	Towanda, PA	Owner	Bernie Diamond (717) 265-9121
Oscar Mayer	Chicago, IL	Owner	John Beck or Chuck Norbert (312) 642-1200
North Slope Borough	Prudoe Bay, AK	Owner	Mike Turner (907) 659-2645
St. Johns University	Stearns County, MN	Owner	Father Gordon Tavis (612) 363-3166
Allied Materials	Stroud, OK	Owner	Charles Kersgieter (918) 968-3541
Herman Miller	Zeeland, MI	Owner	Ed Minerd (616) 772-1766

Table B-2. Incineration Plant Data

Manufacturer: Basic Environmental Engineering

Facility Owner	Fuel Type(1)	Plant Design Capacity(2) lb/hr	No. of Primary Units	Unit Model No.	Unit Capacity lb/hr	Year Installed
The Nelson Co.	W	2,500	1	2500	2,500	1972
Masonite Corp.	Ind.	10,000	1	6000	10,000	1978
Oscar Mayer	Ind. (Pl)(3)	3,000	1	3000	3,000	1981
North Slope Borough	MSW, Ind.	10,000	1	5000	6,000	1981
St. Johns Univ.	MSW	5,400	1	3000	5,400	1981
Allied Materials	Ind.(4)	8,000	1	7000	8,000	1981
Herman Miller, Inc.	Ind.(5)	3,500	1	3500	3,500	1981

(1) W = wood; Ind. = industrial waste; Pl = plastic; MSW = municipal solid waste
(2) Based on a fuel heating value = 6800 Btu/lb
(3) Includes acid sludge (6,500 Btu/lb)
(4) Can also fire fuel oil
(5) Shredded to 2-3 inch particle size

Table B-3. Ancillary Equipment Data

Manufacturer: Basic Environmental Engineering

Incinerator Owner	Heat Exchanger					Type of Air Pollution Control	Type of Ash Cooling	Type of Ash Removal (2)
	Type (1)	No. of Passes	Form of Recov. Energy	Production Rate lb/hr	Pressure psig			
The Nelson Co.	FT	1	Steam			None		M
Masonite Corp			FG/PH (3)			None		A
Oscar Mayer	WT,WW	1	Steam	17,000	220	Scrubber		A
North Slope Borough	WT,WW	1	Hot water			None		A
St. Johns University	WT,WW	1	Steam/ Electricity	15,000 (4)	175	None		A
Allied Materials	WT,WW	1	Steam	38,000	200	None		A
Herman Miller, Inc.	WT	1	Steam/ Electricity	20,000	250	None		A

(1) F = firetube; W = watertube
(2) Manual (M); Automatic (A)
(3) Flue gas used for process heating (FH/PH)
(4) Design steam rate

Table B-4. Operation and Maintenance Data

Incinerator Manufacturer: Basic Environmental Engineering

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System(2) Modifications		Operating Problems(3)	Records(4)
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year(1)	Com-pleted	Proposed		
The Nelson Co.	2,500	0	1	0	8	5	50	0	7	None	None	R	
Masonite Corp.													
Oscar Mayer	2,000	3	9	6	24	4	50	72	0	H	IF,S	BF,ARS	
No. Slope Borough					24	7		AR(5)	AR	None	None		
St. Johns Univ.	3,670	1	9		24	7	50	0	36	FR,CR	ARS	ARS	
Allied Materials	3,000–8,000	0.1	9	0.1	24	7	52	None		H,RS	None	R	
Herman Miller, Inc.		2	8	2	24	7	52	0	14	None	None	None	

(1) Excludes weekly maintenance period
(2) H = hearth; IF = induced draft fan; S = scrubber; CR = condenser; ARS = ash removal system; FR = feed ram; RS = refractory seal
(3) R = refractory; BF = boiler fouling; ARS = ash removal system
(4) Available (A); Not available (N/A)
(5) As required (AR)

Table B-5. Capital Cost Data[1]

Incinerator Manufacturer: Basic Environmental Engineering

Owner	Equipment[2]	Other Costs[3]	Total Cost	Year Costs Incurred
The Nelson Co.				
Masonite Corp.				
Oscar Mayer	1,000,000			1978/79
North Slope Borough			2,780,000	
St. Johns Univ.	1,400,000	1,000,000	2,400,000	1981
Allied Materials	1,500,000	1,000,000	2,500,000	1980
Herman Miller, Inc.				

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities (excludes land cost)

Table B-6. Recurring O&M Expenditures(1)

Incinerator Manufacturer: Basic Environmental Engineering

Owner	Labor	Elect. Power	Water	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
The Nelson Co. Masonite Corp.					None	I(4)		
Oscar Mayer					None			
North Slope Borough								
St. Johns Univ.								
Allied Materials								
Herman Miller, Inc.								

(1) Dollars per year (1980/81); excludes interest, depreciation and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Insignificant (I)

Appendix C

BRULÉ INCINERATORS

Table C-1. Facility Contact Data

Incinerator Manufacturer: Brulé Incinerators
Contact: W.J. Niemac (312)388-7900

Owner	Location	Operator	Contact/Phone No.
A. O. Smith	Milwaukee, WI	owner	Al Matner (414)477-4000
Springs Industry	Springfield, NC	owner	Lynn Toleson (803)547-2901

Table C-2. Incineration Plant Data

Incinerator Manufacturer: Brulé

Incinerator Owner	Location	Waste Type(1)	Plant(2) Design Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit(2) Capacity lb/hr	Year In-stalled
A.O. Smith	Milwaukee, WI	Ind. (P,W)	2,000	1	FG4-17	2000	1981
Springs Ind.	Springfield, NC	Ind. (P,W,C)	2,000	1	FG4-17	2000	1982

(1) Ind. = industrial; P = paper; C = corrugated; W = wood
(2) Fuel heating value = 6,800 Btu/lb

Table C-3. Ancillary Equipment Data

Incinerator Manufacturer: Brulé

Plant Owner	Location	Heat Exchanger Type(1)	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig	Type of Air Pollution Control	Type of Ash Cooling(2)	Type of Ash Removal(3)
A. O. Smith	Milwaukee, WI	FT	1	Steam	9,000	150	Wet Scrubber		HC
Springs Ind.	Springfield, NC	FT	1	Steam	12,000	150	None	Q	C,Ct

(1) F = firetube
(2) Q = quenched
(3) HC = direct discharge into holding container; C = conveyed; Ct = continuous

Table C-4. Operation and Maintenance Data

Incinerator Manufacturer: Brulé

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System[2] Modifications		Operating Problems[3]	Records[4]
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year[1]	Com-pleted	Proposed		
A.O. Smith	2000	0	1	0.1	5	5	50		10	CA		R,F	N/A
Springs Ind.		3[5]	9	0	24	5	52	4-8	8-10[6]	H	None	B	A

(1) Extended downtime
(2) CA = combustion air system; H = hearth
(3) R = refractory; F = feed mechanism; B = material burnout
(4) Available (A); Not available (N/A)
(5) Day shift only
(6) Since May 1982

Table C-5. Capital Cost Data (1)

Incinerator Manufacturer: Brulé

Owner	Equipment (2)	Other Costs (3)	Total Cost	Year Costs Incurred
A.O. Smith	600,000	200,000	800,000	1981
Springs Ind.	450,000	550,000	1,000,000	1982

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities (excludes land cost)

Table C-6. Recurring O&M Expenditure Data(1)

Incinerator Manufacturer: Brulé

Facility Owner	Labor	Elect. Power	Water	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
A.O. Smith	51,000		1,100			5,000		
Springs Ind.								

(1) Dollars per year (1980/81); excludes interest, depreciation and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemical for water treatment and control of slagging

Appendix D

COMPTRO DIVISION, SUNBEAM EQUIPMENT CORP.

Table D-1. Facility Contact Data

Incinerator Manufacturer: Sunbeam Equipment Corporation, Comptro Division, Meadville, PA
Contact: Ed Donley (814)724-1456

Owner	Location	Operator	Contact/Phone No.
U.S. Navy, JAX	Jacksonville, FL	Owner	Mr. LeVasser (904)772-3357
Ford Motor Co.	Saline, MI	Owner	Carl Gerten (313)429-4911
Reynolds Metal Co.	Darlington, PA	Owner	Ed Stearling (215)873-0840
Corning Glass Co.	Corning, NY	Owner	Bill Siever (607)974-7920

Table D-2. Incineration Plant Data

Incinerator Manufacturer: *Sunbeam Equipment Corporation, Comptro Division*

Incinerator Owner	Waste Type (1)	Plant Design Capacity (2) lb/hr	No. of Primary Units	Unit Model No.	Unit Capacity lb/hr	Year Installed
U.S. Navy, JAX	RDF (NW)	6,000	3(3)	A-48	2,000	1980
Ford Motor Co.	*Ind.* (W,C)	2,670	1	A-50	2,670	1980
Reynolds Metal Co.	Ind. (So)	2,670	1	A-50	2,670	1978
Corning Glass Co.	Ind. (P)	2,670	1	A-50	2,670	1981

(1) Ind. = industrial/commercial plant waste; RDF = re.use derived fuel; C = corrugated paper; NW = navy waste; P = newsprint and mixed paper; So = solvents; W = wood
(2) Fuel heating value = 6,500 Btu/lb
(3) One unit on stand-by

Table D-3. Ancillary Equipment Data

Incinerator Manufacturer: Sunbeam Equipment Corp., Comptro Division

Incinerator Owner	Heat Exchanger: Type (1)	Heat Exchanger: No. of Passes	Heat Exchanger: Form of Recovered Energy	Heat Exchanger: Production Rate lb/hr	Heat Exchanger: Pressure psig	Type of Air Pollution Control	Type of Ash Cooling (2)	Type of Ash Removal (3)
U.S. Navy, JAX	WT	2	Steam	6000	125	None	Q	C
Ford Motor Co.	FT	1	Steam	8000	30	None	Q	C,Ct
Reynolds Metal Co.	FT	1	Steam		150	Scrubber	Q	C

(1) FT = firetube; WT = watertube
(2) Q = quenched
(3) C = conveyed; Ct = continuous

Table D-4. Operation and Maintenance Data

Incinerator Manufacturer: Sunbeam Equipment Corp., Comptro Division

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System Modifications[2]		Operating Problems[3]	Records[4]
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year[1]	Com-pleted	Proposed		
U.S. Navy, JAX	1,330	1	15	0	24	5	52	AR[5]	AR		FS	R,F,AR	A
Ford Motor Co.	2,000	0.1	4	0.1	24	6	48	48	20		FE,FR	None	N/A
Reynolds Metal Co.		0	3	0	AR	AR	AR	AR		LI	Shutdown	PC	N/A
Corning Glass Co.	1,400	0.4	3	2	13	5		4		WCH	None		

(1) Extended downtime
(2) FE = feed entry or guillotine door modification; FR = modification of feed ram (may include water cooling system); FS = feed water system modification; LI = liquid injection capability; WCH = water cooled hearth installed
(3) R = refractory; F = feed system; AR = ash removal system; PC = pollution control equipment
(4) Available (A); Not available (N/A)

Table D-5. Capital Cost Data[1]

Incinerator Manufacturer: Sunbeam Equipment Corp., Comptro Division

Owner	Cost of Equipment[2]	Other Costs[3]	Total Cost	Year Costs Incurred
U.S. Navy, JAX			2,800,000	1978-79
Ford Motor Co.	425,000	25,000	450,000	1980
Reynolds Metal Co.				
Corning Glass Co.	1,350,000	150,000	1,500,000	1981

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities

Table D-6. Recurring O&M Expenditure Data[1]

Incinerator Manufacturer: Sunbeam Equipment Corp., Comptro Division

Owner	Labor	Elect. Power	Water	Aux. Fuels[2]	Chem-icals[3]	Residue Disposal	Spare Parts	Total O&M
U.S. Navy, JAX	447,200	11,360	I[4]	46,700	0	0	160,700	666,000
Ford Motor Co.		2,500				I[4]	0	
Reynolds Metal Co.								
Corning Glass Co.								

(1) Dollars per year (1981/82); excludes interest and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Insignificant

Appendix E

CONSUMAT SYSTEMS

Table E-1. Facility Contact Data

Incinerator Manufacturer: Consumat Systems, Richmond Virginia
Contact: Tom Barker (804) 746-4120

Facility Owner	Location	Operator	Contact/Phone No.
U.S. Army	Fort Eustis, VA	Owner	Jerry Salzberry (804) 878-5096
University of New Hampshire Lamprey Regional Solid Waste Coop.	Durham, NH	Owner	Malcolm Chase (603) 868-1086
City of North Little Rock	North Little Rock, AR	Manufacturer	Mayor Thompson (501) 374-2233
City of Osceola	Osceola, AR	Manufacturer	Mr. Staley Fletcher (501) 563-5102
City of Salem	Salem, VA	Owner	William Paxton (703) 389-8601
Rolscreen Company	Pella, IA	Owner	Dave Smith (515) 628-1000
Caterpillar Tractor Co.	Aurora, IL	Owner	Joe Kendall (312) 859-5045
Steelcase Company	Grand Rapids, MI	Owner	Dave Dornbos (616) 247-2975
Amway Corporation	Ada, MI	Owner	Neil Hikade (616) 676-6870
Wellman Industries	Johnsonville, SC	Owner	Walter Robinson (803) 386-2011

Table E-1. Facility Contact Data (cont.)

Facility Owner	Location	Operator	Contact/Phone No.
Cassia County	Burley, ID	Wilder Construction Co.	Doyle Cahoon (208) 676-3510
Town of Windham	Windham, CT	Owner	Don White (203) 456-1721
Park County	Park County, MT		Ed Flatt (406) 222-6120
Charlottetown Energy from Waste Plant	Prince Edward Is. Canada		Bob Russell (416) 226-7195
City of Miami	Miami, OK	Manufacturer	Walt Beckman (918) 542-9511
City of Red Wing	Red Wing, MN		Dean Massett (612) 388-6734
Township of Gennesee	Gennesee, MI	Manufacturer	William C. Ayre (313) 640-2000
City of Batesville	Batesville, AR	Owner	Mayor Shirrell (501) 793-3420
General Motors Corp	Baltimore, MD	Owner	Jim Wilson (301) 955-9477
City of Auburn	Auburn, ME	Manufacturer	Charles Morrison (207) 786-2426

Table E-1. Facility Contact Data (cont.)

Facility Owner	Location	Operator	Contact/Phone No.
B.F. Goodrich	Woodburn, IN	Owner	Mr. Wolfe (216) 374-3545
City of Dyersburg	Dyersburg, TN	Owner	Bob Kirk (901) 285-4353
City of Portsmouth	Portsmouth, NH	Manufacturer	Calvin Canney (603) 431-2000
Lockheed	Sunnyvale, CA	Owner	

Table E-2. Incineration Plant Data

Incinerator Manufacturer: Consumat Systems

Facility Owner	Fuel Type (1)	Plant Design (2) Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit (2) Capacity lb/hr	Year Installed
The Pentagon	Ind. (P)		1	CS-1000	1,650	
U.S. Army	MSW	3,300	2	CS-1000	1,650	1981
Lamprey Region Solid Waste Coop.	MSW	9,000	3	CS-1600	3,000	1980
City of North Little Rock	MSW	8,400	4	CS-1200	2,100	1977
City of Osceola	MSW, Ind.	4,200	2	CS-1200	2,100	1980
City of Salem	MSW	8,400	4	CS-1200	2,100	1978
Rolscreen Co.	Ind. (P,W)	2,100	1	CS-1200	2,100	1979
Caterpillar Tractor Co.	Ind. (P,W)	4,200	2	CS-1200	2,100	1980
Steelcase Co.	Ind. (Sl,P)	2,100	1	CS-1200	2,100	1980
Amway Corp.	Ind. (P,W)	2,100	1	CS-1200	2,100	1981
Lockheed	Ind. (P,M)	2,100	1	CS-1200	2,100	1980
Wellman Ind.	MSW, Ind.	4,200	1	Dual CS-1200	4,200	1981

Table E-2. Incineration Plant Data (cont.)

Facility Owner	Fuel Type[1]	Plant Design[2] Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit[2] Capacity lb/hr	Year Installed
Texas State Dept. of Corrections	Ind. (P,W.C)	1,250[3]	1		1,250[3]	1979
Texas State Dept. of Corrections	Ind. (P,W,C)	8,400[3]	1		8,400[3]	1979
Cassia County	MSW, Ind.	4,200	1	Dual CS-1200	4,200	1981
Town of Windham	MSW, Ind.	9,000	3	CS-1600	3,000	1981
Park County	MSW	6,000	1	Dual CS-1600	6,000	1982
Charlotte Town	MSW	9,000	3	CS-1600	3,000	1982
City of Miami	MSW (R)	9,000	3	CS-1600	3,000	1982
City of Red Wing	MSW	6,000	1	Dual CS-1600	6,000	1982
Township of Gennesee	MSW	8,200	2	CS-2000	4,100	1980
City of Batesville	MSW (R)	4,100	1	CS-2000	4,100	1981

Table E-2. Incineration Plant Data (cont.)

Facility Owner	Fuel Type[1]	Plant Design[2] Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit[2] Capacity lb/hr	Year Installed
General Motors Corp.	Ind.	12,300	3[4]	CS-2000	4,100	1981
City of Auburn	MSW	16,400	4	CS-2000	4,100	1981
B.F. Goodrich	Ind.	4,100	1	CS-2000	4,100	1981
City of Dyersburg	MSW	8,200	2	CS-2000	4,100	1980
City of Portsmouth	MSW	16,100	4	CS-2000	4,100	1982
City of Blytheville	MSW	4,100	4			1975

(1) MSW = municipal solid waste; RDF = refuse derived fuel; Ind. = industrial/commercial plant waste; C = corrugated paper; M = metals; P = newsprint and mixed paper; Pl = plastic; R = rubber; Sl = sludge; So = solvents; T = trash; W = wood
(2) Based on a fuel heating value = 6,800 Btu/lb
(3) Estimate
(4) One unit on stand-by

Table E-3. Ancillary Equipment Data

Incinerator Manufacturer: Consumat Systems

Incinerator Owner	Heat Exchanger: Type(1)	Heat Exchanger: No. of Passes	Heat Exchanger: Form of Recovered Energy	Heat Exchanger: Production Rate lb/hr	Heat Exchanger: Pressure psig	Type of Air Pollution Control	Type of Ash Cooling(2)	Type of Ash Removal(3)
The Pentagon	WT	1	Steam			None	Q	HR
U.S. Army	WT	1	Steam			None	Q	HR
Lamprey Region Solid Waste Coop.	WT	1	Steam			None	Q	HR
City of North Little Rock	WT	1	Steam			None	Q	HR
City of Osceola	WT	1	Steam	10,000	130	None	Q	HR
City of Salem	WT	1	Steam			None	Q	HR
Rolscreen Co.	WT	1	Steam			None	Q	HR
Caterpillar Tractor Co.	WT	1	Steam			None	Q	HR
Steelcase Co.	WT	1	Steam			None	Q	HR
Amway Corp.	WT	1	Steam			None	Q	HR
Lockheed	WT	1	Steam			Baghouse	Q	HR

Table E-3. Ancillary Equipment Data (cont.)

Incinerator Owner	Heat Exchanger Type (1)	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig	Type of Air Pollution Control	Type of Ash Cooling (2)	Type of Ash Removal (3)
Wellman Ind.	WT	1	Steam			None		HR
Cassia County	WT	1	Steam			None		HR
Town of Windham	WT	1	Steam			Baghouse		HR
Park County	WT	1	Steam			None		HR
Charlotte Town	WT	1	Steam			None		HR
City of Miami	WT	1	Steam			None		HR
City of Red Wing	WT	1	Steam			None		HR
Township of Gennesee	WT	1	Steam			None		HR
City of Batesville	WT	1	Steam			None		HR
General Motors Corp.	WT	1	Steam			None		HR
City of Auburn	WT	1	Steam			Baghouse		HR
B.F. Goodrich	WT	1	Steam			None		HR

Table E-3. Ancillary Equipment Data (cont.)

Incinerator Owner	Heat Exchanger Type(1)	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig	Type of Air Pollution Control	Type of Ash Cooling(2)	Type of Ash Removal(3)
City of Dyersburg	WT	1	Steam			None		HR
City of Portsmouth	WT	1	Steam			None		HR
City of Blytheville	WT	1	Steam			None		HR

(1) WT = watertube
(2) Q = quenches
(3) HR = hydraulic ram

Table E-4. Operation and Maintenance Data

Incinerator Manufacturer: Consumat Systems

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Operating Schedule			Maintenance Schedule		System Modifications (2)		Operating Problems (3)	Records
		Supervisors	Operators	Maintenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year (1)	Completed	Proposed		
The Pentagon													
Fort Eustis	2,000	1	7	1	24	5		D(4)					
Lamprey Regional Solid Waste Coop.	7,500	1	8	2	24	7	50	AR(4)	10	FE,S			
City of North Little Rock	7,900	2	7		24	5	52	AR					
City of Osceola	3,500	0	9	1	24	5	52	4	2				
City of Salem	8,400	1	8	2	24	5	V(4)	V	AR	FR,B, ARS			
Rolscreen Co.			4					3	10	AS,ARS, B,FE	IN	R	
Caterpillar Tractor Co.													
Steelcase Co.	2,500	0.3	5	0	24	5	52	4		BT	LI	R	
Amway Corp.	2,000		1	1	24	7		8	3	FE	C	R	

Table E-4. Operation and Maintenance Data (cont.)

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Operating Schedule			Maintenance Schedule		System Modifications(2)		Operating Problems(3)	Records
		Supervisors	Operators	Maintenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year (1)	Completed	Proposed		
Lockheed	2,200	1	4	0	24	7	40	AR	60	TF	C, IN, FS, ATR		
Wellman Industries		1	9	0	24	7	52	AR	3	FR			
Cassia County	4,200	1	6	1	24	5.5	52	24-48	None	FP, P	IN		
Town of Windham		1	9	1	24	6		10-48	None				
Park County													
Charlotte Town			10-11		24	5-7	50						
City of Miami			11		24	5		4					
City of Red Wing		1	6										
Township of Gennessee			12		24	5							
City of Batesville	3,326		9		24	5		4				R	
General Motors Corp.	7,500	0	3	0						FR	FR	R	

Table E-4. Operation and Maintenance Data (cont.)

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Operating Schedule			Maintenance Schedule		System Modifications(2)		Operating Problems(3)	Records
		Supervisors	Operators	Maintenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year (1)	Completed	Proposed		
City of Auburn	14,000				24	5.5	52	1.5		BH,SM			
B.F. Goodrich													
City of Dyersburg													
City of Portsmouth			15-16		24	7	52						
City of Blytheville													

(1) Extended downtime
(2) AS = anti-slagging chemical utilization; ARS = ash removal system; ATR = ash transfer ram; B = blower replacement; BH = baghouse installation; BT = boiler or blow-down modification/tube replacement; C = installation or modification of air/steam temperature controls; FE = feed entry or guillotine door modification; FP = feedwater preheater installation; FR = feed ram (may include water cooling system); FS = feedwater system; IN = addition of insulation; LI = addition of liquid injection; P = pump modification (de-aerator and/or sump); S = stack modification; SM = steam vent muffler added; TF = tipping floor modification
(3) R = refractory
(4) AT = as required; V = variable; D = daily

Table E-5. Capital Cost Data[1]

Incinerator Manufacturer: Consumat Systems

Facility Owner	Equipment[2]	Other Costs[3]	Total Cost	Year Costs Incurred
The Pentagon				
Fort Eustis			1,524,000	1979
Lamprey Regional Solid Waste Coop.	1,500,000	1,800,000	3,300,000	1981
City of No. Little Rock	969,000	551,000	1,520,000	1977
City Osceola	530,000	670,000	1,200,000	1977
City of Salem			1,900,000	1978
Rolscreen Co.	350,000	250,000	600,000	1979
Caterpillar				
Steelcase Co.	500,000	700,000	1,200,000	1979
Amway Corp.	400,000	698,000	1,098,000	
Lockheed	700,000	1,840,000	2,540,000	1980
Wellman Industries	500,000	700,000	1,200,000	1979
Cassia County			1,400,000	1981
Town of Windham	2,033,800[4]	2,116,200	4,150,000	1980

Table E-5. Capital Cost Data(1) (cont.)

Facility Owner	Equipment(2)	Other Costs(3)	Total Cost	Year Costs Incurred
Park County				
Charlottetown				
City of Miami	1,570,000	1,570,000	3,137,000	1981
City of Red Wing	1,240,000	260,000	2,500,000	1981
Township of Gennesee	1,300,000	700,000	2,000,000	
City of Batesville	620,000	340,000	960,000	1980
General Motors Corp.				
City of Auburn	844,700	2,135,300	3,980,000	1979
B.F. Goodrich				
City of Dyersburg				
City of Portsmouth				
City of Blytheville				

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building, and utilities (excludes land cost)
(4) Includes baghouse

Table E-6. Recurring O&M Expenditure Data(1)

Incinerator Manufacturer: Consumat Systems

Facility Owner	Labor	Elect. Power	Water/ Sewer	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
The Pentagon								
Fort Eustis								
Lamprey Regional Waste Coop.								521,507(4)
City of North Little Rock	127,000	19,237	6,402	23,076	3,400		65,700(5)	244,800(6)
City of Osceola	96,000	7,346(7)		1,492	0	602	16,000	121,724(8)
City of Salem								
Rolscreen Co.	80,000					2,640		
Caterpillar Tractor Co.								
Steelcase Co.	51,100	1,625		7,000		17,760	10,000	
Amway Corp.				3-5,000		34,000	3-5,000	
Lockheed	252,700		I(9)	54,000	I	4,725		
Wellman Industries								
Cassia County								
Town of Windham	192,000	8,000				8,000		600,000

Table E-6. Recurring O&M Expenditure Data(1) (cont.)

Facility Owner	Labor	Elect. Power	Water/ Sewer	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
Park County								
Charlottetown								
City of Miami								472,000
City of Red Wing	150,000							350,000
Township of Gennesee								700,000(10)
City of Batesville	109,240		35,800(11)		11,300	0		189,832
General Motors Corp.								
City of Auburn								588,000
B.F. Goodrich								
City of Dyersburg								
City of Portsmouth								
City of Blytheville								

(1) Dollars per year (1980/81); excludes interest, depreciation, and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Buuget estimate

Table E-6. Recurring O&M Expenditure Data[1] (cont.)

(5) Includes some labor costs
(6) 1979 data. Total O&M for 1981 was $275,000 (Consumat operating fee); actual cost was $420,000.
(7) Includes water
(8) 1980 data. In 1981 O&M was approximately $444,000
(9) Insignificant
(10) Currently not operating due to poor economics
(11) Includes electric power and water

Appendix F

ECONO-THERM

Table F-1. Facility Contact Data

Incinerator Manufacturer: Econo-Therm Energy System
Contact: Greg Halverson (612)938-3100

Owner	Location	Operator	Contact/Phone No.
Outboard Marine Corp.	Galesburg, IL	Owner	Gary Pipes (309)343-0141
Palos Community Hospital	Palos Heights, IL	Owner	Tom Mulrooney (312)361-4500
Midwest City Hospital	Midwest City, OK	Owner	Don Ragland (405)737-4411

Table F-2. Incineration Plant Data

Manufacturer: Econo-Therm

Incinerator Owner	Location	Fuel Type[1]	Plant Design Capacity[2] lb/hr	No. of Units	Unit Model No.	Unit Capacity lb/hr	Year In-stalled
Outboard Marine Corp.	Galesburg, IL	C,W		1	CA-1500	1500	1979
Palos Community Hospital	Palos Heights, IL	H	1500	1	CA-1500	1500	1979
Midwest City Hospital	Midwest City, OK	H	1000	1	CA-1000	1000	1977

(1) C = corrugated; W = wood; H = hospital waste
(2) Based on a fuel heating value = 6,800 Btu/lb

Table F-3. Ancillary Equipment Data

Manufacturer: Econo-Therm

Incinerator Owner	Heat Exchanger Type[1]	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig	Type of Air Pollution Control	Type of Ash Cooling	Type of Ash Removal[2]
Outboard Marine Corp.	F	1	Steam		11	None		M
Palos Community Hospital	F	1	Steam		80	None		M
Midwest City Hospital	F	1	Steam	300	60	None		M

(1) F = firetube; W = watertube
(2) M = manual

Table F-4. Operation and Maintenance Data

Manufacturer: Econo-Therm

Facility Owner	Typical Throughput lb/hr	No. of Operating Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System Modifications		Operating Problems(2)	Records(3)
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year(1)	Com-pleted	Proposed		
Outboard Marine Corp.			1-2		8-16	5	50	6	12	None	None	None	
Palos Community Hospital	700		2		16	7	52	15		None	None	AR	A
Midwest City Hospital	500-700		2		20-22	6	52	3-4	2	None	None	AR	A

(1) Exludes weeking maintenance period.
(2) AR = ash removal system.
(3) Available (A).

Table F-5. Capital Cost Data(1)

Manufacturer: Econo-Therm

Owner	Equipment	Supporting Facilities(2)	Total Cost	Year Costs Incurred
Outboard Marine Corp.				1979
Palos Community Hospital	95,000(3)			1979
Midwest City Hospital				1977

(1) Dollars
(2) Includes building and utilities (excludes land cost)
(3) Cost of boiler only

Table F-6. Recurring O&M Expenditures(1)

Manufacturer: Econo-Therm

Owner	Labor	Elect. Power	Water	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
Outboard Marine Corp.								
Palos Community Hospital	29,000		I(4)		1000-2000	18,000		
Midwest City Hospital	4,600(5)		I		700	200	500	

(1) Dollars per year (1980/81); excludes interest, depreciation and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Insignificant (I)
(5) No full-time operator assigned to system

Appendix G

ENVIRONMENTAL CONTROL PRODUCTS, INC.

Table G-1. Facility Contact Data

Incinerator Manufacturer: Environmental Control Products, Inc.
Contact: B.F. Kolanowski (704) 588-1620 or Mark Hoffman (415) 893-1507

Facility Owner	Location	Operator	Contact/Phone No.
Colgate-Palmolive Co.	Jeffersonville, IN	Owner	(812) 283-6611
Dow Chemical	Freeport, TX	Owner	Mr. Evans (713) 238-1227
Freightliner Corp.	Mt. Holly, NC	Owner	Bob Brown (704) 827-7511
General Electric Co.	Hickory, NC	Owner	James Stock (704) 462-3000
International Paper Co.	Lewisburg, PA	Owner	Baker Lumpkin (717) 524-2281
Maine Rubber International	Westbrook, ME	Owner	Lester Porter (207) 856-6386
Monarch Rubber	Baltimore MD	Owner	(301) 342-8510
Offset Paperback Manufacturers	Dallas, PA	Owner	(717) 675-5261
Pillsbury Co.	Springfield, IL	Owner	Warren Lair (217) 528-2501

Table G-1. Facility Contact Data (cont.)

Facility Owner	Location	Operator	Contact/Phone No.
The Quaker Oats Co.	Cedar Rapids, IA	Owner	Larry Heese (319) 362-3121
The Quaker Oats Co.	Rockford, IL	Owner	Robert Decannio (815) 964-4671
The Trane Co.	Clarksville, TN	Owner	Tom Allen (615) 645-6471
Groveton Paper	Groveton, NH	Owner	
Tootsie Roll	Chicago, IL	Owner	
Fort Leonard Wood	130 miles west of St. Louis, MO	Engineering Applications	

Table G-2. Incineration Plant Data

Manufacturer: Environmental Control Products

Facility Owner	Waste Fuel Type[1]	Plant Design[2] Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit Capacity lb/hr	Year Installed
Pillsbury	Ind. (W,CP)	1500	1		1500	1980
General Electric	Ind. (P,W)		1			1974
Quaker Oats	Ind. (P,W,C,Pl)	2500	1	2500	2500	1981
Colgate-Palmolive	Ind. (C,Pl,W)	1900	1	2500-T	2500	1980/81
International Paper Co.	Ind. (P,Cl,Pl)	1350	1	2000	1350	1980
Maine Rubber International	Rubber Tires	1350	1	250-T	1350	1981
Monarch Rubber	Rubber	1000	1	1500	1000	1980/81
Quaker Oats	Ind. (C,P)	2500	1	2500	2500	1980
Trane Co.	Ind. (W,C,Pl)	2000	1	2000	2000	1979
Freightliner Corp.	Ind. (W,P)	1080	1		1080	1979
Groveton Paper	P, MSW	2000	1	2500-T	2000	1975
Tootsie Roll	C,W,P	2000	1		2000	1981
Fort Leonard Wood (U.S. Army)	MSW, (W)	6300	3[3]		2100	1982

(1) Ind. = industrial; W = wood; C = corrugated; P = paper; Pl = plastic; Cl = cloth; MSW = municipal solid waste
(2) Based on fuel heating value = 6,500 Btu/lb
(3) One unit burns MSW, one unit burns wood, and the third unit is shut down for maintenance

Table G-3. Ancillary Equipment Data

Manufacturer: Environmental Control Products

Incinerator Owner	Heat Exchanger Type[1]	Heat Exchanger No. of Passes	Heat Exchanger Form of Recovered Energy	Heat Exchanger Production Rate lb/hr	Heat Exchanger Pressure psig	Type of Air Pollution Control	Type of Ash Cooling[2]	Type of Ash Removal[3]
Pillsbury	F	1	Steam	5000	90	None	Q	C,I
Gen. Electric	F	1	Steam	2000	250	None		M
Quaker Oats	F	1	Steam		145	None	Q	C
Colgate-Pal-molive	F	1	Steam	4000	110	None	Q	C,Ct
International Paper Co.	F	1	Steam	4000	125	None	Q	C,I
Maine Rubber Co.	F	1	Steam		110	None	Q	C,Ct
Monarch Rubber	F	3	Steam		130	Baghouse	Q	C,I
Quaker Oats	F	1	Steam	4000		None	Q	C,Ct
Trane	F	1	Steam	2500	125	None	Q	C,Ct
Freightliner	F	1	Steam	5800		None	Q	B
Groveton Paper			Steam					
Tootsie Roll			Steam					
Fort Leonard Wood			Steam					

(1) W = watertube; F = firetube
(2) Q = quenched
(3) M = manual; I = intermittent; Ct = continuous; C = conveyed; B = back hoe

Table G-4. Operation and Maintenance Data

Manufacturer: Environmental Control Products

Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day: Supervisors	Operators	Maintenance	Operating Schedule: Hours per Day	Days per Week	Weeks per Year	Maintenance Schedule: Hours per Week	Days per Year (1)	System Modifications (2): Completed	Proposed	Operating Problems (2)	Records (3)
Pillsbury	1500	0	2	0	16	6	48	6	Many	F,AR	F	F,AR,R,E,O	A
General Electric		0	1	0	8	5	49	2	3-4	B,S	F,FEP	R,F	N/A
Quaker Oats		0	1	0.1	10-12	5	52	3-4	Many	R	AR	R	A
Colgate-Palmolive	1100	0	1.5	0.3	12-24	5	48	5	72	F,AR,H	None	F	A
International Paper Co.	1200-1300	0	2	0	16	5	52	4		AR,H,F	None	H,R[4]	A
Maine Rubber Co.	1350	0	30[5]	0	24	5	50		40	AR,R		AR,R	
Monarch Rubber	1000	0	2	1.5	16	5	52	12	Many	CA	APC	AR,Sl,F[4]	None
Quaker Oats	1500-1800	0	1.5	4.5	24	5	50	15-20	Many	AR,S	None	F,AR,R	
Trane	1000		1		16	5	50	4-5	35-50	F,R	AR	E,R,AR	A
Freightliner		1		8	5	52	2		F,E	None	None	None	
Groveton Paper	2000	1	3	AR	24	5	51	AR[4]	AR	FR	R,ARS		
Tootsie Roll	2000	1	1	AR	6	5	48	AR	AR	None	None		
Fort Leonard Wood	4200	1	7	1	24	7	52	40	AR		FR,FE,ARS	R,ARS	

(1) Excludes weekly maintenance period
(2) F = feed system; AR = ash removal system; R = refractory; E = electrical; O = operational; B = boiler; S = stack; FEP = front-end processing; H = hearth; CA = combustion air system; AP = air pollution control; Sl = slagging; fouling
(3) Available (A); Not available (N/A)
(4) System has been down more than 50 percent of planned operating time
(5) Includes haulers, loaders, choppers and maintenance personnel

Table G-5. Capital Cost Data[1]

Manufacturer: Environmental Control Products

Owner	Equipment [2]	Supporting Facilities [3]	Total Cost	Year Costs Incurred
Pillsbury			450,000	1980
General Electric				1974
Quaker Oats			490,000	1980
Colgate-Palmolive	500,000	200,000[4]	700,000	1980/81
International Paper Co.	225,000	75,000	300,000	1980
Maine Rubber Co.				1981
Monarch Rubber Co.			250,000	1980
Quaker Oats	600,000	150,000	750,000	1979
Trane Co.	220,000	100,000[4]	320,000	1979
Freightliner				1979
Groveton Paper				
Tootsie Roll	305,000	125,000	430,000	1981
Fort Leonard Wood			3,500,000	1982

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities (excludes land cost)
(4) Includes shredder

Table G-6. Recurring O&M Expenditure Data

Manufacturer: Environmental Control Products

Facility Owner	Labor	Elect. Power	Water	Aux. Fuels (2)	Chemicals (3)	Residue Disposal	Spare Parts	Total O&M
Pillsbury	20,000 (4)	I	I	13,000	200		4000-5000	
General Electric	23,000	I	I	None				
Quaker Oats		1,800				3,600	I	
Colgate-Palmolive	27,000	11,500-15,600 (5)	I	4,800			I	
International Paper Co.			I	30,000-36,000		I		
Maine Rubber Co.		1						
Monarch Rubber	25,000		I			15,600		
Quaker Oats			I					
Trane	32,000		I	20,000-25,000		3,000	8000	
Freightliner	21,000							
Groveton Paper								
Tootsie Roll								
Fort Leonard Wood								

(1) Dollars per year (1981/82)
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Includes labor and materials for maintenance only
(5) System includes shredder

Appendix H

KELLEY COMPANY

Table H-1. Facility Contact Data

Incinerator Manufacturer: Kelley Company, Milwaukee, Wisconsin
Contact: Roy Miller (414) 352-1000

Facility Owner	Location	Operator	Contact/Phone No.
International Harvestor Co.	Moline, IL	Owner	Phil Ollman (309) 752-3409
Anderson Corp.	Bayport, MN	Owner	Dick Fowler (612) 439-5150
K.W. Muth	Sheboygan, WI	Owner	Bill Morganroth (414) 458-9181
U.S. Air Force	Marietta, GA	Owner	Jack Ramsey (404) 424-2223
Digital Equipment Corp.	Merrimak, NH	Owner	Brian Hogan (617) 329-3900
Alan-Bradley Company	Milwaukee, WI	Owner	Ron Erikson Mr. Reiny Molner (414) 671-2000
Bowen McLauglin	York, PA	Owner	Jerry Oxford (717) 225-4781
Continental Can	Milwaukee, WI	Owner	Mr. Anderson (414) 963-3476

Table H-1. Facility Contact Data (cont.)

Facility Owner	Location	Operator	Contact/Phone No.
General Electric	Matoon, IL	Owner	Abe Milborn (217) 235-4081
Xerox	Columbus, OH	Owner	Mr. Nick Masucci (614) 253-0892
Rockwell International	Marysville, OH	Owner	Rick Farber (513) 644-3015
William Rorer Co.	Ft. Washington, PA	Owner	Mr. Schevarz (215) 628-6000
Freightliner Corp.	Portland, OR	Owner	Fred Glubrecht (503) 240-7135

Table H-2. Incineration Plant Data

Incinerator Manufacturer: Kelley Company

Facility Owner	Fuel Type (1)	Plant (2) Design Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit (2) Capacity lb/hr	Year Installed
International Harvestor Co.	Ind. (P,Pl,R)	2,600	2	1280	1,300	1977
Anderson Corp.	Ind. (3)	5,200	2	2500	2,600	
K.W. Muth	Ind. (W,C,P,F)	1,000	2	1280	1,000	1977
U.S. Air Force	Ind. (P,W)	2,500	1	2500	2,600	1982
Digital Equipment Corp.	Ind. (P,F)	2,500	1	2500	2,600	1982
Alan Bradley	Ind. (P,C,W)	1,080	1	1280	1,280	1977
Bowen McLauglin	Ind.		1	1280		
Continental Can	Ind. (3)	1,300	1	1280		1981
General Electric	Ind. (P,C,W)	1,100	1	1280	1,100	1979/80
Xerox	Ind. (P,C,W,F)	1,000	1	1280	1,000	1977
Rockwell International	Ind. (P,W)	2,000	1	2500	2,000	1977
William Rover	Ind. (P,C,Pl,W)	1,600	1	1280	1,280	1979
Freightliner Corp.	Ind. (W,C,P)	1,165	1	1280	1,165	1979

(1) Ind. = industrial/commercial plant waste; C = corrugated paper; F = food waste; P = paper
Pl = plastic; R = rubber; W = wood
(2) Fuel heat value provided by owner = 6,500 Btu/lb
(3) Equipped for liquid injection
(4) Includes liquid injection of 15 drums/day x 6 days/week of methyl ethyl ketone and tramp oils

Table H-3. Ancillary Equipment Data

Incinerator Manufacturer: Kelley Company

Incinerator Owner	Heat Exchanger: Type[1]	Heat Exchanger: No. of Passes	Heat Exchanger: Form of Recovered Energy	Heat Exchanger: Production Rate lb/hr	Heat Exchanger: Pressure psig	Type of Air Pollution Control	Type of Ash Cooling[2]	Type of Ash Removal[3]
International Harvestor Co.	FT	2	Steam					
Anderson Corp.	FT	2						
K.W. Muth	FT	1	Steam					
U.S. Air Force	FT	1	Steam					
Digital Equip. Corp.			Steam					
Alan Bradley	FT	1	Steam	4000-5000	60-90	None	WS	HC
Bowen McLaughin								
Continental Can			Steam					
General Electric			Steam	212	15	None		HR,HC
Xerox	F	1	Hot Water			None	Q	I,C
Rockwell	F	1	Hot Water			None		M
William Rover	F	1	Steam			None		M
Freightliner	F	1	Steam	1380	125	None		M

(1) FT = firetube
(2) WS = water spray; Q = quenched
(3) HR = hydraulic ram; HC = directly discharged into holding container; C = conveyed from pit;
I = intermittent; M = manually removed

Table H-4. Operation and Maintenance Data

Incinerator Manufacturer: Kelley Company

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System[2] Modifications		Operating Problems[3]	Records[4]
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year[1]	Com-pleted	Proposed		
Int. Harvestor	500[5]	0.1	1-2	0.1	8-16	5	48	0	AR[6]	FR	FE		
Anderson Corp.											LI		
K.W. Muth	2000	1	3	1	24	5	51	AR	AR			R	
U.S. Air Force	2000	0.1	2	0.1	16	5	50	8		ARS	ARS		
Digital Equipment Corp.						8	5	52					
Alan Bradley	250-600	0	2	0	16	5	50	5-6	10-15	None	None	None	A
Bowen McLaughin													
Continental Can		0.1	3		24	5	52	4	AR			IP	
General Electric		0	1.5	0	12	5	49	3	1-2	None	None	None	N/A
Xerox	200	0	3	0	24	5	52	2	5-7	ARS, ACt	None	A,F,R	N/A

Table H-4. Operation and Maintenance Data (cont.)

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System[2] Modifications		Operating Problems[3]	Records[4]
		Super-visors	Oper-ators	Main-tenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year[1]	Com-pleted	Proposed		
Rockwell		0	3	0	24	5	52	4	1	ARS	None	R[7]	N/A
William Rover	1600		1		10-12	5	48	3-4	1	B	None	None	N/A
Freightliner	750		1		8-12	5	52	4	1	ARS	None	None	A

(1) Extended downtime
(2) ARS = ash removal system; FE = feed entry (or guillotine door); FR = feed ram (may include ram water cooling system); LI - liquid injection; R = refractory; ACt = air control; B = boiler
(3) AC = ash conveyor; F = feed control; R = refractory; IP = injection pumps (wear)
(4) Available (A); Not available (N/A)
(5) Currently only operating one unit due to low plant output
(6) As required (AR)
(7) Stack refractory

Table H-5. Capital Cost Data(1)

Incinerator Manufacturer: Kelley Company

Facility Owner	Equipment (2)	Other Costs (3)	Total Cost	Year Costs Incurred
Int. Harvestor	$300,000	15,000	315,000	1976
Anderson Corp.				
K.W. Muth	260,000	45,000	275,000	1976
U.S. Air Force			700,000	1981
Digital Equipment Corp.				
Alan Bradley				
Bowen McLaughin				
Continental Can	400,000	0	400,000	1981
General Electric			182,000	1979
Xerox	125,000	25,000	150,000	1977
Rockwell			500,000	1977
William Rover	150,000	100,000	250,000	1979
Freightliner			285,000	1979

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building, and utilities (excludes land cost)

Table H-6. Recurring O&M Expenditure Data

Incinerator Manufacturer: Kelley Company

Facility Owner	Labor	Elect. Power	Water/ Sewer	Aux. Fuels (2)	Chemicals (3)	Residue Disposal	Spare Parts	Total O&M
Int. Harvestor					200		1,000	
Anderson Corp.								
K.W. Muth	45,000	I (4)	I	5,000	I	I	13,000	65,000
U.S. Air Force						I		
Digital Equipment								
Alan Bradley			I					
Bowen McLaughin								
Continental Can								
General Electric							I	
Xerox	16,000-20,000		I	5,500		3,000	400	
Rockwell	34,000	200	I	12,000	100-200	I		
William Rover								
Freightliner	25,000				1,000	I	200	

(1) Dollars per year (1980/81); excludes interest, depreciation, and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Insignificant

Appendix I

SIMONDS MANUFACTURING CORPORATION

Table I-1. Facility Contact Data

Incinerator Manufacturer: Simonds Manufacturing Corp., Auburndale, Florida
Contact: O.E. Collins (813) 967-8566

Owner	Location	Operator	Contact/Phone No.
Halifax Medical Center	Daytona Beach, FL	Owner	Frank Bailey (904) 258-1595
V.A. Hospital	Tampa, FL	Owner	C.W. Baumgardner (813) 971-4500
Holy Cross Hospital	Ft. Lauderdale, FL	Owner	R.J. Miller (305) 771-8000
North Shore Medical Center	Miami, FL	Owner	Gil Curler (305) 835-6000
St. Vincent's Hospital	Jacksonville, FL	Owner	Clark Tiller (904) 387-7300

Table I-2. Incineration Plant Data

Manufacturer: Simonds Manufacturing

Facility Owner	Fuel Type(1)	Plant Design(2) Capacity lb/hr	No. of Primary Units	Unit Model No.	Unit(2) Capacity lb/hr	Year Installed
Halifax Medical Center	HW(3)	1250	1		1250	1977
V.A. Hospital	HW	750(3)	1		750	1978
Holy Cross Hospital	HW	1300	1		1300	1981
North Shore Medical Center	HW	1000	1		1000	1982
St. Vincents Hospital	HW		1			1979

(1) Hospital waste (HW)
(2) Based on fuel heating value = 6,500 Btu/lb
(3) Downgraded from 1200 lb/hr

Table I-3. Ancillary Equipment Data

Manufacturer: Simonds Manufacturing

Incinerator Owner	Heat Exchanger					Type of Air Pollution Control	Type of Ash Cooling(2)	Type of Ash Removal(3)
	Type(1)	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig			
Halifax Medical Center	F	1	Steam		100	None		M
V.A. Hospital	F	1				None		M
Holy Cross Hospital	F	1	Steam		110	None		M
North Shore Medical Center			Hot Water			None	Q	C,Ct
St. Vincent's Hospital	F	2	Steam	5,000	125	None		M

(1) F = firetube
(2) Q = quenched
(3) M = manual; C = conveyed ; Ct = continuous

Table I-4. Operation and Maintenance Data

Manufacturer: Simonds Manufacturing

Facility Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Operating Schedule			Maintenance Schedule		System Modifications (2)		Operating Problems (3)	Records (4)
		Supervisors	Operators	Maintenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year (1)	Completed	Proposed		
Halifax Medical Center	750	0	1	0	8-9	7	52	7	5	CA	None	R	A
V.A. Hospital		0	2	0	8	5	52	10	10	None	F	R, C, B, AR (5)	A A
Holy Cross Hospital		0	1	0	8	6-7	52	5	3	None	None	None (6)	A
No. Shore Medical Center	750-1100	0	1	0.1	8-10	6	52		1 (7)	None	None	None	A
St. Vincent's Hospital		0	2	0	8-1/2	5	52	15	15	None	None	None (6)	N/A

(1) Excludes weekly maintenance period
(2) CA = combustion air system
(3) R = refractory; AR = ash removal; C = controls; B = burner; F = feed system
(4) Available (A); Not available (N/A)
(5) Manual dry ash removal inconvenient and hazardous
(6) Dissatisfied with manual ash removal system
(7) Since June 1982

Table I-5. Capital Cost Data(1)

Manufacturer: Simonds Manufacturing

Facility Owner	Equipment(1)	Other Costs(2)	Total Cost	Year Costs Incurred
Halifax Medical Center	100,000	150,000	250,000	1977
V.A. Hospital			>300,000	1978
Holy Cross Hospital				1981
North Shore Medical Center			187,000	1982
St. Vincent's Hospital				1979

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities (excludes land cost)

Table I-6. Recurring O&M Expenditure Data

Manufacturer: Simonds Manufacturing

Facility Owner	Labor	Elect. Power	Water/ Sewer	Aux. Fuels(2)	Chemicals(3)	Residue Disposal	Spare Parts	Total O&M
Halifax Medical Center	15,000		I(4)	30,000		1100	<1500	
V.A. Hospital	20,000–26,000	I	I	24,000	None	2100	1000	
Holy Cross Hospital	41,000	I	I			I	200–300	
North Shore Medical Center	24,000							
St. Vincent's Hospital	21,000		I		I		500	

(1) Dollars per year (1980/81); excludes interest, depreciation and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemicals for water treatment and control of slagging
(4) Insignificant

Appendix J

MISCELLANEOUS MANUFACTURERS

Table J-1. Facility Contact Data

Incinerator Manufacturer	Facility Owner	Location	Operator	Contact/Phone No.
Clear Air	Waxahachie, TX	Waxahachie, TX	Owner	James Davis (214) 937-7330
Morse Boulger	Columbia Presbyterian Hospital	New York, NY	Owner	Mr. Barbookles (212) 694-2000
Washburn and Granger	U.S. Navy	Mayport, FL	Owner	Edward Hoeffner (201)278-1965
Therm-Tec	St. Luke's Hospital	San Francisco, CA	Owner	Stan Macintyre (415) 647-8600
U.S. Smelting Furnace Co.	National Security Administration	Ft. Mead, MD	Owner	Keith Cutler (618)233-0129

AD-A125 543 SURVEY OF SMALL SCALE HEAT RECOVERY INCINERATORS(U) CAL RECOVERY SYSTEMS INC RICHMOND CA J K TUCK ET AL. FEB 83 CEL-CR-83-017 N62583-82-MR-460 2/2

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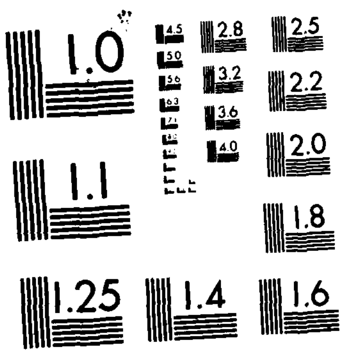

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table J-2. Incineration Plant Data

Incinerator Manufacturer: Various

Incinerator Manufacturer	Incinerator Owner	Location	Fuel Type (1)	Plant Design Capacity lb/hr (2)	No. of Primary Units	Unit Model No.	Unit Capacity lb/hr (2)	Year Installed
Clear Air	City of Waxahachie	Waxahachie, TX	MSW	5,000	2		2500	1982
Therm-Tec	St. Lukes Hospital	San Francisco, CA	HW	1,250	1	1000	1250	1982
Washburn and Granger	U.S. Navy	Mayport, FL	NW	3,000	1			
Morse Boulger	Columbia Presbyterian Hospital	New York, NY	HW	N/A	1	N/A	N/A	1980
U.S. Smelting and Furnace Co.	National Security Administration	Ft. Mead, MD	Pl	1,600	2	1500	800	1982

(1) MSW = municipal solid waste; Pl = plastic; HW = hospital waste; NW = Navy waste
(2) Based on fuel heating value = 6,500 Btu/lb

Table J-3. Ancillary Equipment Data

Incinerator Manufacturer: Various

Incinerator Owner	Heat Exchanger Type(1)	No. of Passes	Form of Recovered Energy	Production Rate lb/hr	Pressure psig	Type of Air Pollution Control	Type of Ash Cooling(2)	Type of Ash Removal(3)
Waxachachie	FT	1	Steam	10,000–11,000	200	None	Q	C,CT
St. Luke's Hospital	FT	1	Steam	3,000	60	Scrubber		C
U.S. Navy			Steam					
Columbia Pres. Hospital	FT	1	Steam	7,000	160	Scrubber		M
National Security Administration	FT		Steam	3,100	100	Baghouse		HC

(1) FT = firetube
(2) Q = quenched; WS = water spray
(3) M = manual; HC = direct discharge into holding container; C = conveyed; Ct = continuous

Table J-4. Operation and Maintenance Data

Incinerator Manufacturer: Various

Owner	Typical Throughput lb/hr	No. of Assigned O&M Personnel/Day			Posted Operating Schedule			Maintenance Schedule		System(2) Modifications		Operating Problems	Records(3)
		Supervisors	Operators	Maintenance	Hours per Day	Days per Week	Weeks per Year	Hours per Week	Days per Year(1)	Completed	Proposed		
Waxahachie, TX	3300	3(4)	9	0	24	6	52	12	Few	None	None	None	A
St. Luke's Hospital	1000	0	9	0	24	6-1/2	52	4	0(5)	None	None	None	A
U.S. Navy	1330				24	5		15	AR(6)				
Columbia Pres. Hospital		0	2	0	8	7	52		7	None	None	None	N/A
National Security Ad.	600		5		8	5	52	2-3	1(5)	None	None	None	A

(1) Extended downtime
(2) CA = combustion air system; R = refractories; F = feed mechanism; H = hearth; B = material burnout; AR = ash removal system; Hd = hydraulics
(3) Available (A); Not available (N/A)
(4) Day shift only
(5) Limited operating experience
(6) As required

Table J-5. Capital Cost Data[(1)]

Incinerator Manufacturer: Various

Owner	Equipment[(2)]	Other Costs[(3)]	Total Cost	Year Costs Incurred
Waxahachie, TX	1,600,000	600,000	2,200,000	1982
St. Luke's Hospital			200,000	1982[(4)]
U.S. Navy				
Columbia Presbyterian Hospital				1980
National Security Administration				

(1) Dollars
(2) Includes incinerator and heat recovery equipment
(3) Includes installation, building and utilities (excludes land cost)
(4) Purchased at 1979 cost

Table J-6. Recurring O&M Expenditure Data[1]

Incinerator Manufacturer: Various

Facility Owner	Labor	Elect. Power	Water/ Sewer	Aux. Fuels[2]	Chemicals[3]	Residue Disposal	Spare Parts	Total O&M
Waxahachie, TX	190,000[4]	18,000-20,000[4]	5,000[4]		<1,200[4]	8,000-10,000[4]		
St. Lukes Hospital			I[5]		500	1,600	4,000	
U.S. Navy	145,000	35,400	I	58,546	1,156		25,740	265,842
Columbia Pres. Hospital								
National Security Administration								

(1) Dollars per hear (1980/81); excludes interest, depreciation and insurance
(2) Includes fuel for secondary combustion chambers and front-end loaders
(3) Includes chemical for water treatment and control of slagging
(4) Projected costs
(5) I = insignificant

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